Town of Durham
New Hampshire

Salt Reduction Plan For:

College & Reservoir Brooks

Original Adoption Date: *4/15/2015*
Revision 1:
Revision 2:

Legal Notices:

These are General guidelines used by the Town of Durham Department of Public Works. Each decision to mobilize crews, extend operation hours, and to apply de-icing, anti-icing, and pre-treatment materials is made based on particular weather conditions, past experience, and the availability of resources and therefore may not adhere strictly to this policy.

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1.0 Introduction & Background

The New Hampshire Department of Environmental Services (DES) and the US Environmental Protection Agency (EPA) have classified College Brook as impaired for chloride concentrations that exceed state water quality standards.

In order to meet water quality standards, significant reductions from current chloride loading are required. The Town of Durham New Hampshire, Department of Public Works (Durham) has agreed to reduce the amount of chlorides applied during snow and ice removal operations while maintaining an acceptable level of service (LOS) on roadways, sidewalks, and parking lots. This salt reduction plan will serve as a scope of work for implementation of ongoing salt reduction efforts.

College Brook Watershed: The watershed consists of an approximately 0.88 square mile drainage area located entirely in Durham, NH and encompassing parts of on the University of New Hampshire Campus. In the absence of a Total Maximum Daily Load study, the College Brook c*hloride loading threshold of 226 Tons of NaCl per year* was estimated using the methodology published by Trowbridge.[1] The watershed is experiencing an *approximated loading of 576 tons per year of chloride*. In order to meet water quality standards the College Brook watershed will need approximately 61% load reduction.

Durham is responsible for winter maintenance of 3.01 Miles of roadway within the watershed. UNH is responsible for 28.21 acres of parking lot, 5.44 miles of roadway, and 9.73 miles of sidewalk within College Brook, and the NHDOT has 2.24 miles of roadway.

Reservoir Brook Watershed: The watershed consists of an approximately 1 square mile drainage area located entirely in Durham, NH on the University of New Hampshire Campus. With an estimated c*hloride loading threshold of 256 Tons of NaCl per year,* the watershed is currently experiencing an *approximated loading of 493 tons per year of Chloride*. In order to meet water quality standards the Reservoir Brook watershed will need approximately 48% load reduction.

The Town of Durham is responsible for 1.79 miles of roadway within the watershed and 0.77 miles of roadway classified as unmaintained. UNH is responsible for winter maintenance of 30.24 Acres of parking lot, 1.35 Miles of roadway, and 8.73 miles of sidewalk within Reservoir Brook.

[1] Trowbridge, et.al. "Relating Road Salt to Exceedances of the Water Quality Standard for Chloride in New Hampshire Streams." *Environmental Science & Technology*. 2010, 44, 4903–4909

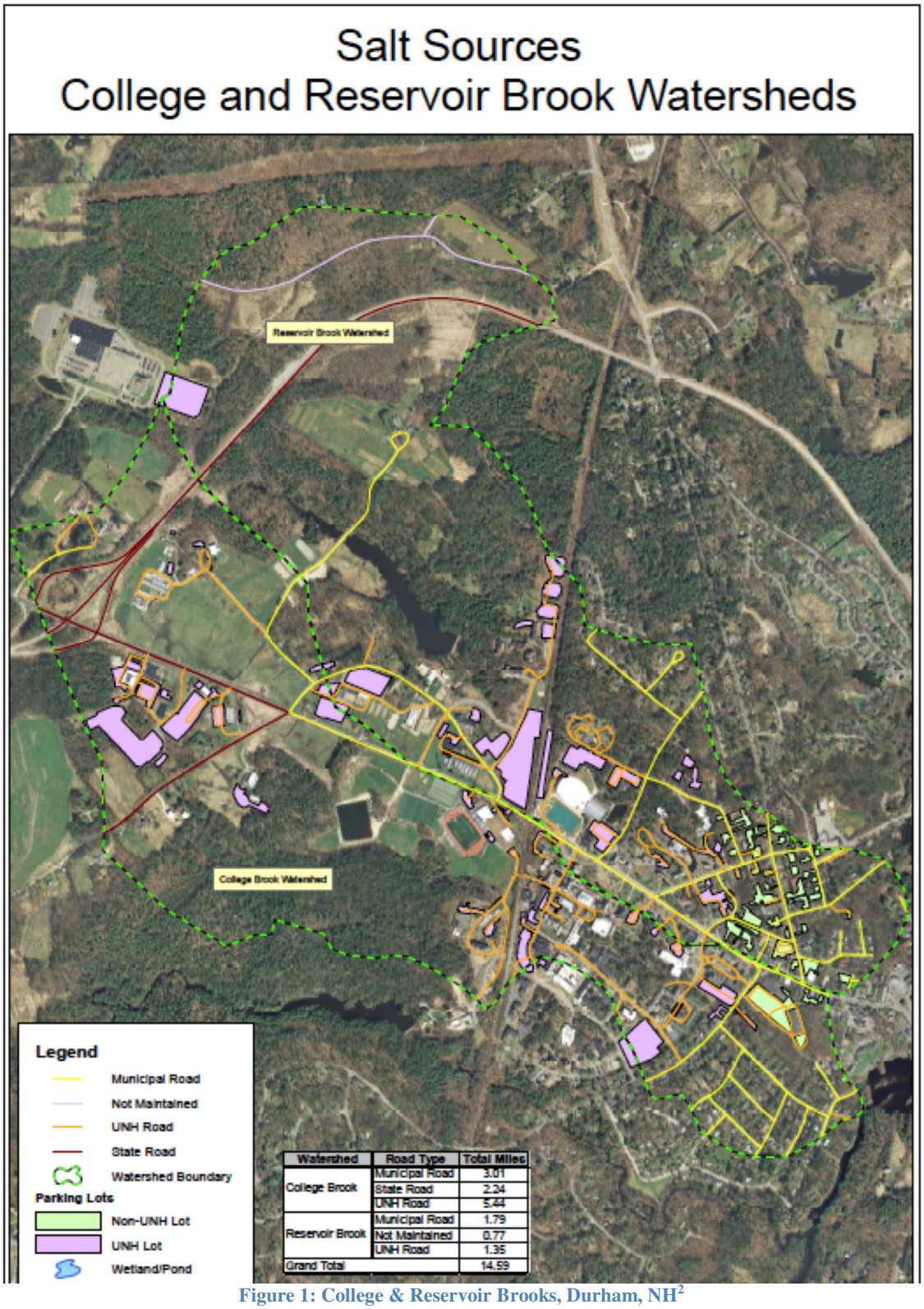

Figure 1: College & Reservoir Brooks, Durham, NH[2]

[2] Image Source: NHDES GIS

Chloride Loading Sources: As evidenced by studies performed on watersheds within the I-93 Corridor from Salem to Manchester, NH as well as numerous other studies within the northern states the primary source of chloride contamination of surface waters is road salt used in winter maintenance. The tables below summarize the paved surfaces within the watershed, the parties responsible for winter maintenance, the estimated chloride loading as well as the predicted Chloride Loading Threshold as calculated by NHDES.

Table 1: Road Miles by Winter Maintainer (Source: NHDES)

Watershed	Road Type	Total Miles
College Brook	Municipal Road	3.01
	State Road	2.24
	UNH Road	5.44
Reservoir Brook	Municipal Road	1.79
	Not Maintained	0.77
	UNH Road	1.35
Grand Total		**14.59**

Table 2: Parking Lot Area by Maintainer (Source: NHDES)

Watershed	Lot Type	Total Acres
College Brook	UNH Lot	27.98
Reservoir Brook	Non-UNH Lot	15.00
	UNH Lot	30.24
Grand Total		**73.21**

Table 3: Sidewalk Length by Maintainer

Watershed	Sidewalk Type	Total Miles
College Brook	UNH Sidewalk	9.73
Reservoir Brook	UNH Sidewalk	8.73
Grand Total		**18.46**

Table 4: College Brook Calculated Salt Loading (Source: NHDES)

College Brook Salt Loading		Annual Loading Rate	Total Annual Salt Load
Roads	State roads	18 tons/lane mi	40.26
	Municipal roads	13 tons/ lane mi	39.08
	UNH roads	13 tons/ lane mi	70.75
Parking Lots	UNH lots	9.46 tons/acre	264.66
	Non-UNH lots	6.4 tons/acre	0.00
Sidewalks	UNH Sidewalks	8 Tons/Mile[3]	77.84
		Total Salt Load	**575.75**

[3] Estimated annual loading rate for report only, rate has not been empirically validated.

Table 5: Reservoir Brook Calculated Salt Loading (Source: NHDES)

Reservoir Brook Salt Loading		Annual Loading Rate	Total Annual Salt Load
Roads	State roads	18 tons/lane mi	0.00
	Municipal roads	13 tons/ lane mi	23.32
	UNH roads	13 tons/ lane mi	17.51
Parking Lots	UNH lots	9.46 tons/acre	286.04
	Non-UNH lots	6.4 tons/acre	96.00
Sidewalks	UNH Sidewalks	8 Tons/Mile[4]	69.84
		Total Salt Load	492.71

Table 6: Predicted Chloride TMDL For College & Reservoir Brooks (Source: NHDES)

Parameter	Units	College	Reservoir
Drainage Area	mi^2	0.88	1.00
	km^2	2.28	2.59
Runoff Coefficient (Note 1)	cfs/mi^2	1.55	1.55
	$m^3/s/km^2$	0.0170	0.0170
Conversion Factor	mg m^3 yr / Mg L s	0.0317	0.0317
Predicted Cl Loading Threshold	Mg Cl / km^2 / yr	54.60	54.60
	Mg NaCl / km^2 /yr	90.02	90.02
	Mg NaCl / yr	205	233
	tons NaCl / yr	226	256
Estimated Actual Loading	tons NaCl / yr	575.75	492.71
Reduction Needed	%	**-60.7%**	**-48%**

2.0 Plan Development

The goal for the Salt Reduction Plan (SRP) is to set a policy and procedural framework to ensure that the Town of Durham, New Hampshire continuously improves winter maintenance operations while effectively and efficiently using road salt during snow and ice removal operations. New practices contained within this plan are intended to reduce the amount of road salt applied thus working towards meeting the required TMDL load reductions while continuing to meet Town's level of service (LOS) requirements.

Durham will provide winter maintenance to ensure the designated LOS to roadways, parking lots and sidewalks is maintained according to applicable state and local legislation while striving to minimize adverse impacts to the environment. These commitments will be met by adhering to the procedures contained within this Salt Reduction Plan:

- Committing to ongoing winter maintenance staff training and education;
- Reporting annual winter salt use data to the NHDES;

[4] Estimated annual loading rate for report only, rate has not been empirically validated.

- Re-evaluating the effectiveness of the Salt Reduction Plan as needed to incorporate new technologies or changes in procedures.

The SRP is meant to be dynamic to allow the Town to evaluate and phase-in any changes, new approaches and technologies in winter maintenance activities in a fiscally sound manner.

To reduce the financial burden the Town will seek funding through the Department of Environmental Services Watershed Assistance Grants program in partnership with The University of New Hampshire, and the UNH Technology Transfer Center. The program will provide limited funding to assist The Town with implementing pilot level best practices to achieve the estimated TMDL load reductions. This SRP has been prepared to implement chloride load reductions and affect environmental improvements on College and Reservoir Brooks.

3.0 Winter Maintenance Overview

Documenting the current winter maintenance program in the town is essential to understanding mechanisms in which actions for chloride reduction can take place. The summary below provides detail on paved surface maintained, material usage, application rates, and level of service policy. The major activities related to winter maintenance are:

Table 7: Winter Maintenance Activities

Snow Plowing	Snow Storage
Salt/Sand Spreading	Sidewalk Plowing & De-icing
Salt & Sand Storage	Install Fire Hydrant Flags
Snow & Ice Removal	Drainage Clearing

Durham currently maintains approximately 62 miles of roads[5], 15 miles of sidewalks and 5 acres of parking lots. This includes public parking facilities and school and police lots.

Materials used in winter maintenance vary annually and are a function of winter weather severity. The table below provides an overview of average material usage.

Table 8: Annual Durham Material Usage Summary

Material	**20013/2014**	
Solids		
Rock Salt (NaCl)	1,050	Tons
Sand		Tons
Liquids		
N/A		

Current salt application rates vary based on equipment limitations for sidewalks. Application rates are approximated using annual loading rates

[5] Source: Durham Records

4.0 Proposed Best Management Practices (BMPs)

4.1 Sidewalk Equipment Upgrade Pilot

Pre 319 Grant Salt Reduction Project: Durham has historically upgraded equipment as necessary and when funding was available. Durham has always been focused on operational efficiency with respect to material usage and equipment replacement and maintenance costs.

Proposed BMP: Durham will purchase One (1) new low salt spreading system for use within college and reservoir brook. This piece of equipment features ground speed oriented spreading and enhanced calibration ability. It is also capable of pre-wetting of de-icing materials.

Equipment/Materials Needs: Partial funding of purchase of new salt spreader, tracor, plow, snowblower combination.

Estimated Reduction: The reductions in table 9 below are conservatively estimated at 15 % in Durham chloride imports to the College Brook Watershed. This is based on typical reductions achieved with similar equipment upgrades in New Hampshire. The new equipment will be used for roadway plowing within that watershed. Durham acknowledges that these reductions are insufficient to meet acceptable watershed loading. The town intends to continually improve salt reductions through ongoing training and experience with the ultimate goal of meeting acceptable chloride loading.

Table 9: Equipment Upgrade Estimated Reductions

Watershed	Existing Imports	Estimated Reduction	Estimated Reduction	Estimated Reduced Imports
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*
College Brook	39.08	15%	5.862	33.218
Reservoir Brook	23.32	15%	3.498	19.822

4.2 Equipment Calibrations

Proposed BMP: Durham will calibrate each spreader unit prior to the winter season using manufacturer information supplemented with T^2 supplied calibration procedures. Calibrated settings will be logged in a master sheet, and stored inside the vehicle. Prior to each storm each truck will be checked to verify that settings are set to dispense the proper amount of chemical for the specific situation Hydraulically

controlled units will be re-calibrated whenever the hydraulic system is altered or maintained.

Properly calibrated equipment will ensure that each spreader is dispensing the appropriate amount of material which will be determined for each storm. It is anticipated that this practice will reduce waste and improve efficiency of chemical dispersion.

Equipment/Materials Needs: Durham will not require any additional equipment.

Estimated Reduction: The reductions in table 10 below are conservatively estimated at 10%. These reductions are only resulting from improved calibration procedures.

Table 10: Calibration Estimated Reductions

Watershed	Existing Imports	Estimated Reduction	Estimated Reduction	Estimated Reduced Imports
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*
College Brook	39.08	10%	3.908	35.172
Reservoir Brook	23.32	10%	2.332	20.988

4.3 BMP Overview Matrix

Table 11: BMP Reduction Overview Matrix for Year 1

BMP	Watersheds	Reduction	
4.1 Equipment Upgrade	College Brook	5.862	Tons/Yr
	Reservoir Brook	3.498	Tons/Yr
4.2 Equipment Calibration	College Brook	3.908	Tons/Yr
	Reservoir Brook	2.332	Tons/Yr
Total Estimated Reduction:		**15.6**	**Tons/Yr**
Total Estimated Durham Salt Imports after BMPs:		**46.8**	**Tons/Yr**

5.0 Implementation Cost & Timeline

Equipment costs reflect a federal cost share of $11,400 of the total $123,341.65 purchase price. The table below summarizes BMP and the associated estimated costs. It should be noted that matching funds will be compliant with 49 CFR18.24 and 49 CFR19.23.

Table 12: Estimated Cost Table

BMP	Equipment	Estimated Cost

4.1 Equipment Upgrade Pilot	**6.0 Low-Salt Spreader**	$11,400
4.2 Improved Calibrations	*No Equipment Required*	$0.00
	Total Project Cost:	**$11,400**
	Total 319 Grant Funds:	**$11,400**

7.0 Reduction Summary

Reductions are estimated uniformly among the sectors (UNH, Town of Durham, State, and Private Sector) at 60.7% for College Brook and 48% for Reservoir Brook. The measures in this salt reduction plan do not reduce loading to a level sufficient to eliminate impairment as illustrated in table 13 below. Potential future salt reduction measures are outlined in section 7.

Table 13: Estimated Total Reductions Needed for Durham

Watershed	Existing Durham Imports	Estimated Total Reduced Durham Imports	Total Estimated Durham Reduction	Durham Chloride Load Target	Remaining % Reduction Needed[6]	Remaining Reduction Needed
	Tons/Year	*Tons/Year*	*Percent*	*Tons/Year*	*Percent*	*Tons/Year*
College Brook	39.08	29.31	25%	15.35	35.7%	13.96
Reservoir Brook	23.32	17.49	25%	12.126	23%	5.364

It should be noted that the University of New Hampshire, NHDOT, and private sector contractors also contribute chlorides through their winter maintenance activity. A summary of the estimated state and municipal reductions are provided in tables 14 and 15 below.

Table 14: Estimated State of NH Reductions

Watershed	Existing Imports State Imports	% Reduction Needed	Reduction Needed	Import Allocation
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*
College Brook	40.26	60.7%	24.43	15.82
Reservoir Brook	0.00	48%	N/A	N/A

[6] Based on original estimated loading

Table 15: Estimated UNH Reductions

Watershed	Existing Imports Town Imports	% Reduction Needed	Reduction Needed	Import Allocation
	Tons/Year	*Percent*	*Tons/Year*	*Tons/Year*
College Brook	413.25	60.7%	250.84	162.21
Reservoir Brook	373.39	48%	226.65	179.22

8.0 Potential Future Reductions

It is acknowledged that the salt reductions outlined in this plan are not sufficient to meet predicted TMDL targets. Durham is considering additional salt reduction alternatives for future implementation as funding becomes available. Potential salt reduction techniques are outlined below.

Ongoing Education: Durham plans on keeping it's operators current on the newest technologies and best management practices through ongoing continuing education of existing and new staff. This training will primarily be through the UNH Technology Transfer Center's Green SnowPro training program.

Equipment Upgrades: As funding becomes available Durham plans to upgrade its remaining equipment to include groundspeed controlled with in cab controls, and pre-wetting equipment. These upgrades have the potential for an additional ~20% reduction of salt usage within the target watersheds.

Anti-Icing: Due to the high capital investment required in producing brine is it unlikely that Durham will begin the use of Anti-Icing in the near future. However collaboration with state winter maintenance professionals to purchase a communal brine maker may be a lower cost alternative to deploying the technology. Anti-Icing has the potential to reduce salt loading by up to 20%.